

National High Frequency Radar Network

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HSRP

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Background

- Mature Technology (30+ years) for Measuring Ocean Current Velocities over Large Coastal Areas
- Numerous Mission-Critical Applications
- Hourly, Near-real-time
- Spatial Resolution ~1 to 6 km
- Relatively Low Maintenance
- IOOS is Developing a Data Management and Distribution System for the Nation

Outline

- Background
- Existing Sites and Data Products
- Regional Applications
- Present and Planned Activities

CODAR Transmit Antenna



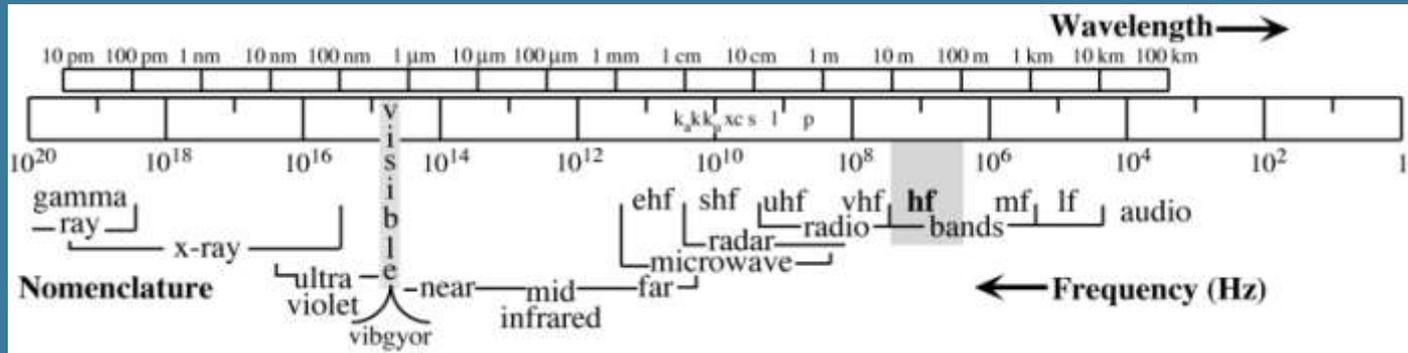
Receive and Transmit Antennas



HF Radar Electronics Enclosure



HF Radar: How It Works



The Plus Side

- Longer Wavelengths than Met Radars → Immune to Precip
- Ranges to 250 km
- Radiates Less Energy than Household Light Bulb
- Mature Technology

The Minus Side

- Interference from Distant Sources, Crowded Radio Spectrum
- Need “Deep” Water = $> 1/2$ the radio wavelength

The Dark Side (not controllable)

- Interference Hard to Mitigate
- Water Wave Nonlinearities

HF Radar: How It Works

Direction Finding Radar

- Where Am I?
- Broad Beam
- Compact Antenna
- Wave Info Limited
- 95% of US HFRs



CODAR

\$105-125K

Beam Forming Radar

- How Fast Am I Going?
- Narrow Beam
- Large Antenna
- Wave Info Easier



WERA

\$180-200K

Portals, Nodes, Sites

- Portals deployed at Rutgers, UCSB, SFSU, SLO, MBARI, SIO, OSU, USM, UMiami, UMaine
- Nodes deployed at SIO, NDBC & Rutgers
- Additional nodes are deployed at JPL, MBARI, USC and SLO (all part of COCMP)
- 29 participating institutions, 100+ sites

Radar Specs

- Velocity Resolution: 2 to 4 cm/s *
- Range Resolution: 0.2 to 6 km **
- Temporal Resolution: 10 to 60 min
- Range Extent: 1 to 200+ km *
- Velocity Accuracy: 5 to 10 cm/s

*Depends on Transmit Frequency, Signal Processing

** Depends on RF bandwidth

What Else Can HF Radar Measure?

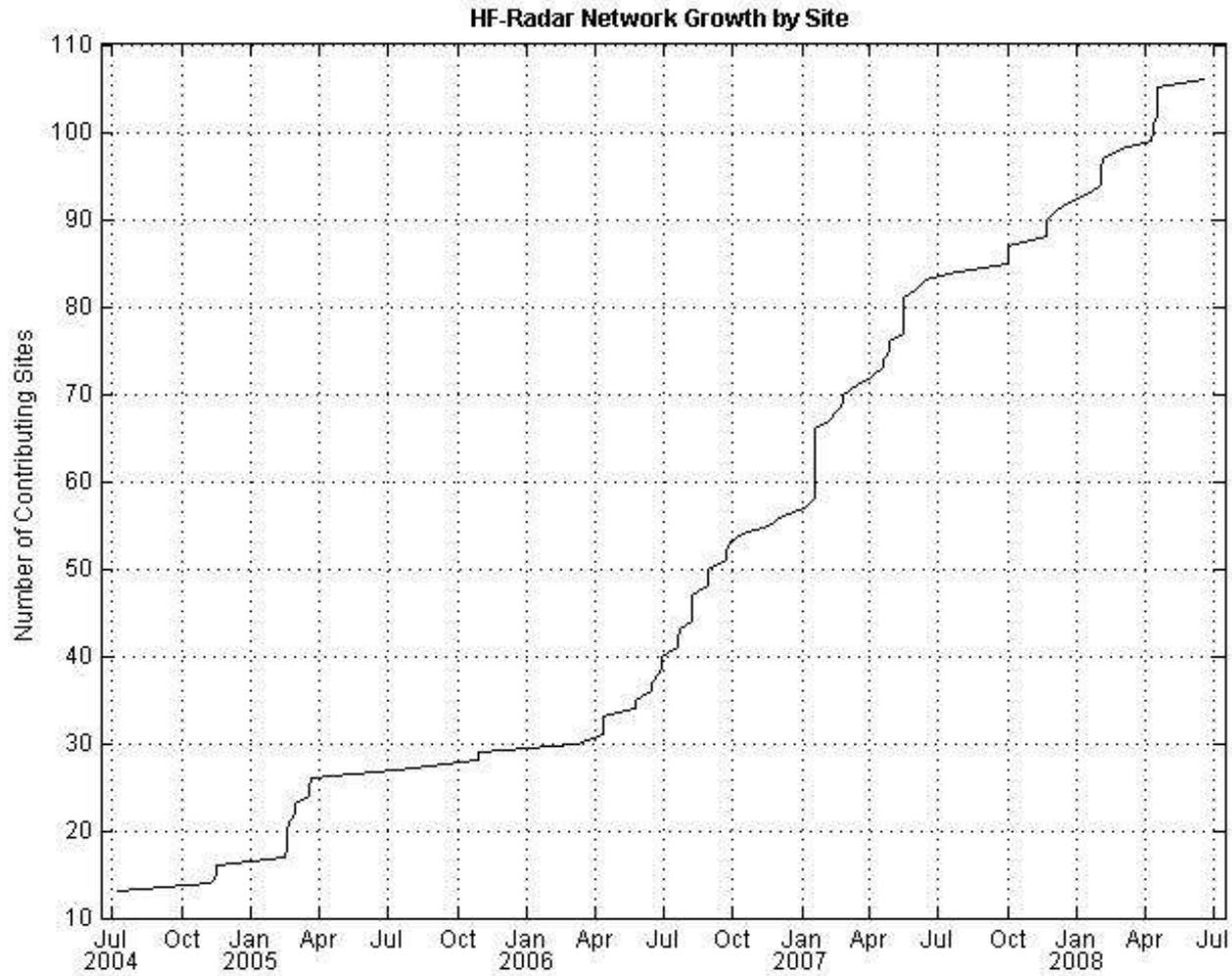
Easiest



Hardest

- Surface Wind Direction
- Surface Current Speed
- Significant Wave Height
- Dominant Wave Period
- Dominant Wave Direction
- Surface Wind Speed
- Non-Directional Wave Spectrum
- Directional Wave Spectrum

Radar Network Growth

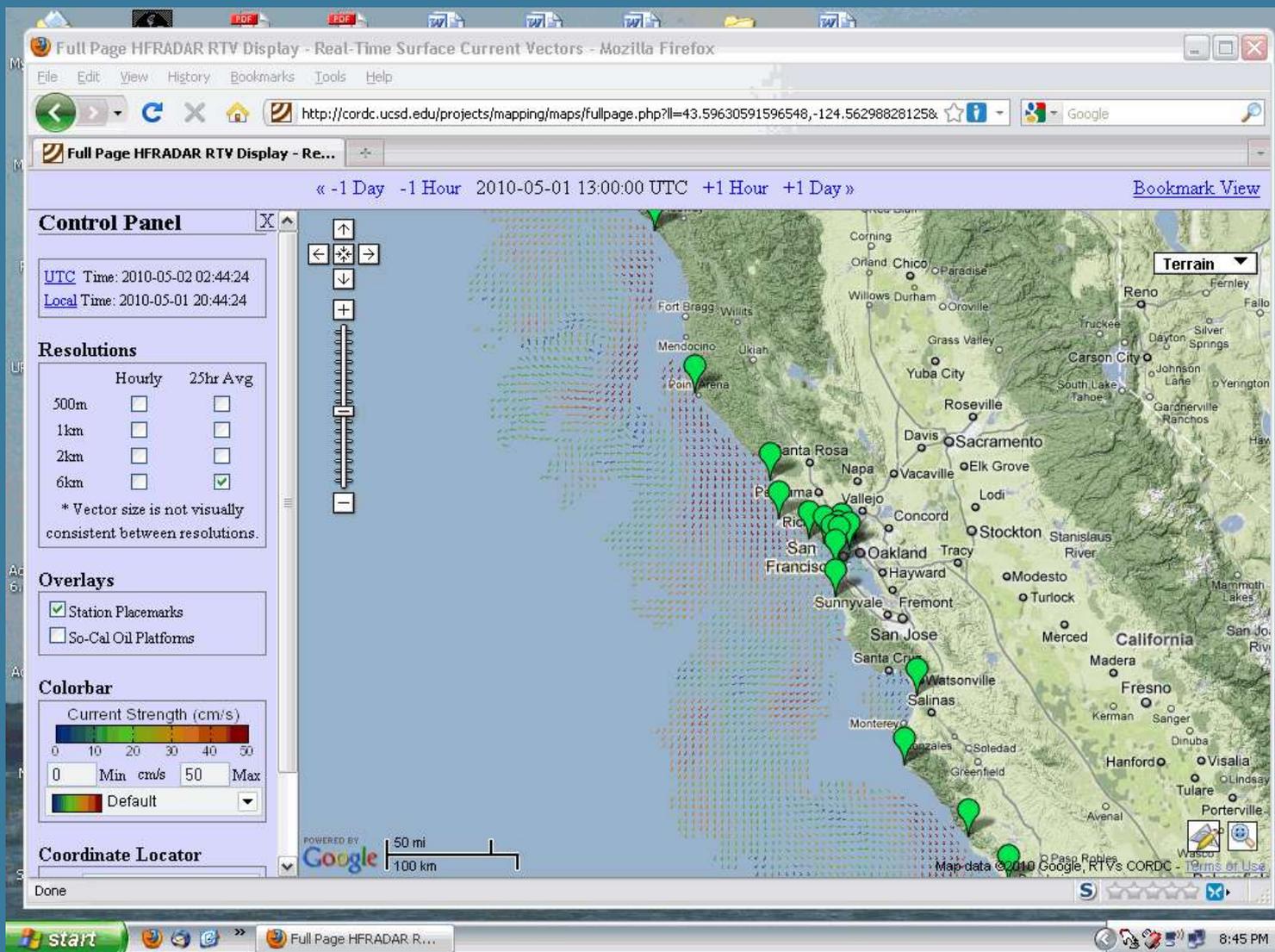


Now, The Big Picture

What HF Radar Provides

[Scripps National HF Radar Data Server](#)

What HF Radar Provides

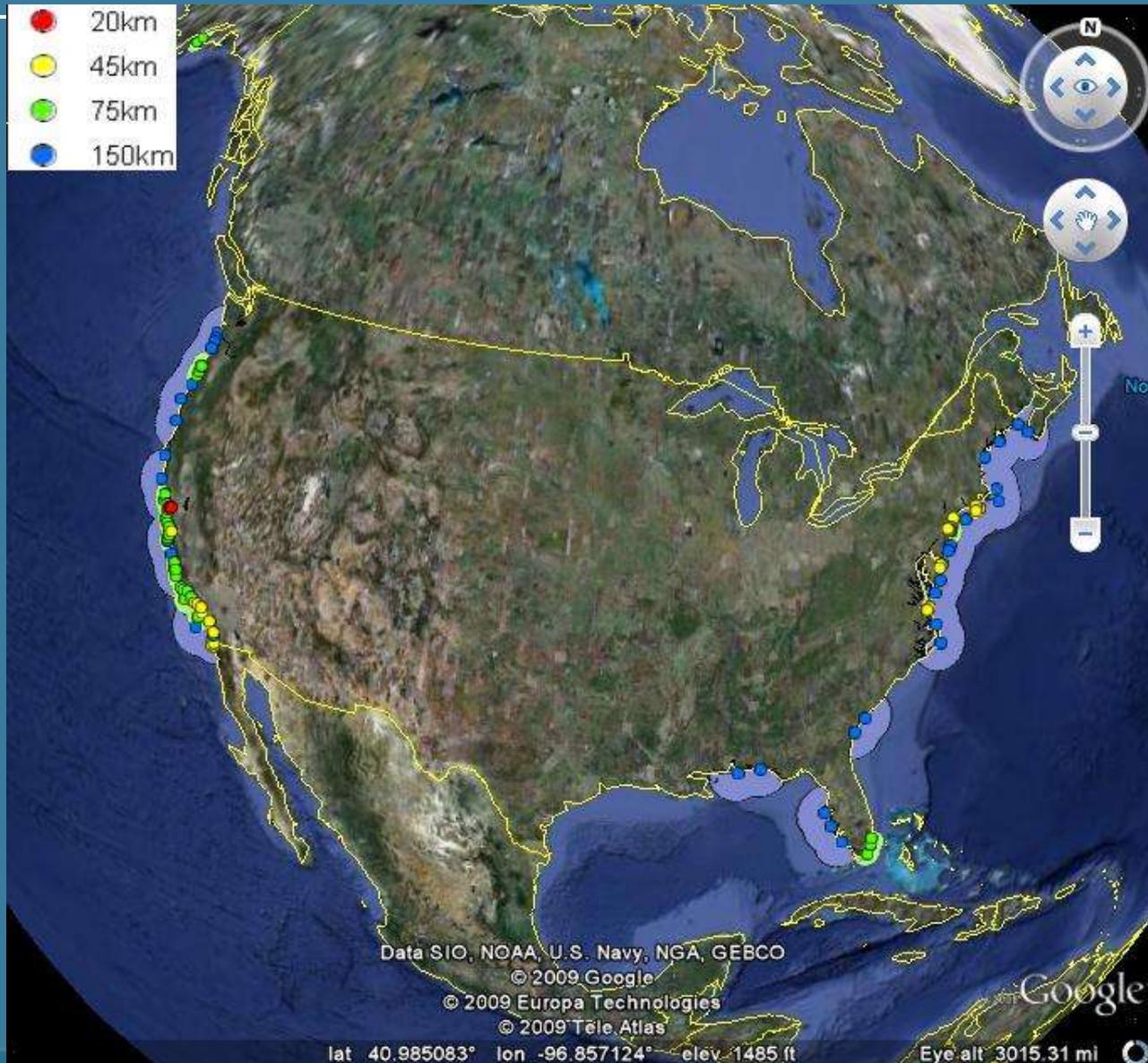


National Network of Regional Associations



- 11 RA s serve the entire US Coastline, including Great Lakes, the Caribbean and the Pacific Territories
- RAs implement the Regional Coastal Ocean Observing Systems (RCOOS)

Google Earth Map: Existing Sites



Google Earth Map: Proposed Sites



Latest CODAR Technology

**New Compact
CODAR
Antenna**

**One Pole =
Receive &
Transmit**

No Side Whips



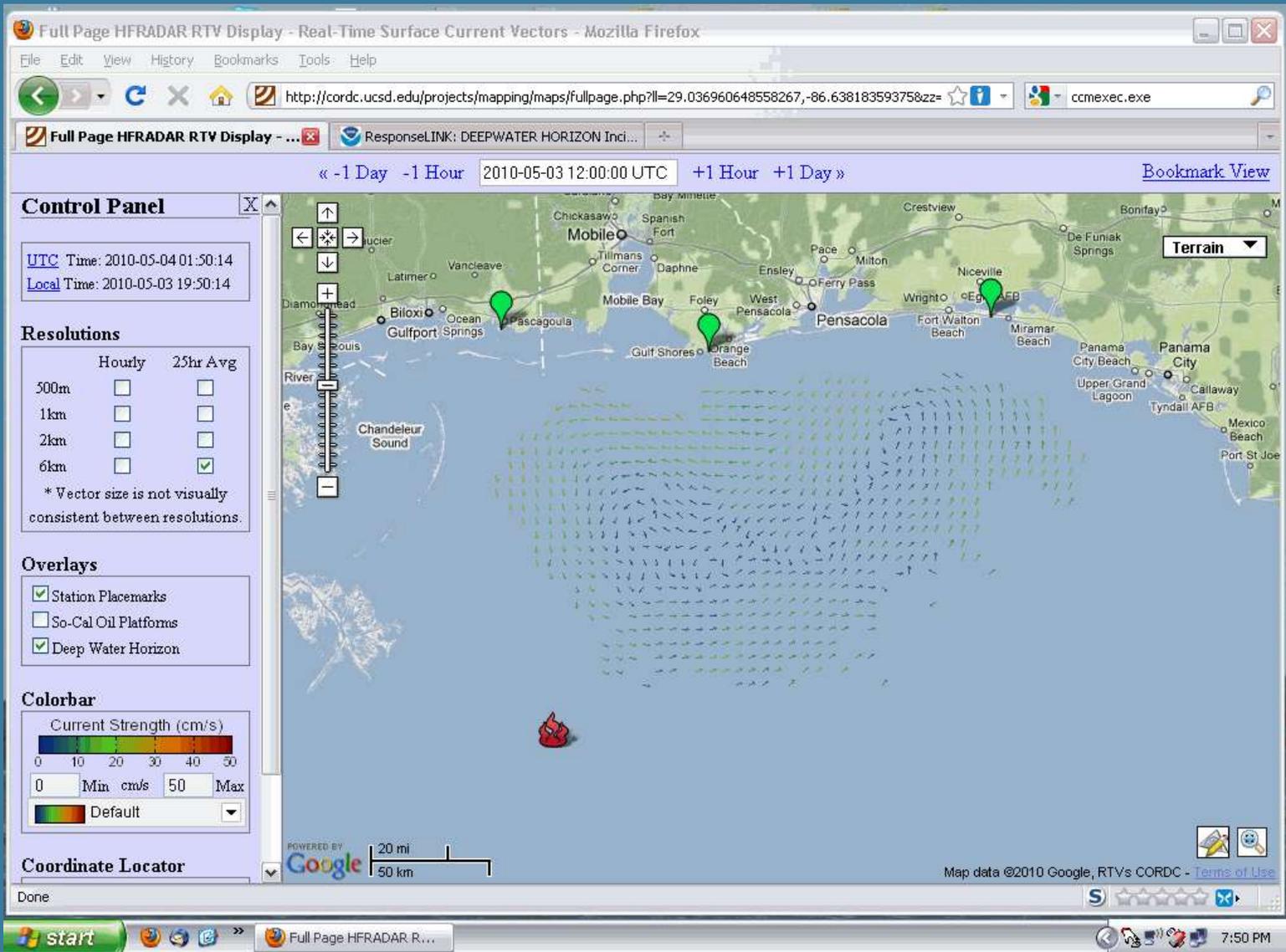
Applications

- Federal, State, Local Agencies
 - USCG Search & Rescue
 - Water quality monitoring
 - Rip current prediction
 - Marine navigation
 - Harmful Algal Bloom Forecasts
 - Fisheries and ecosystem management
 - Oil Spill response, both NOAA and state
 - Hydrodynamic Modeling

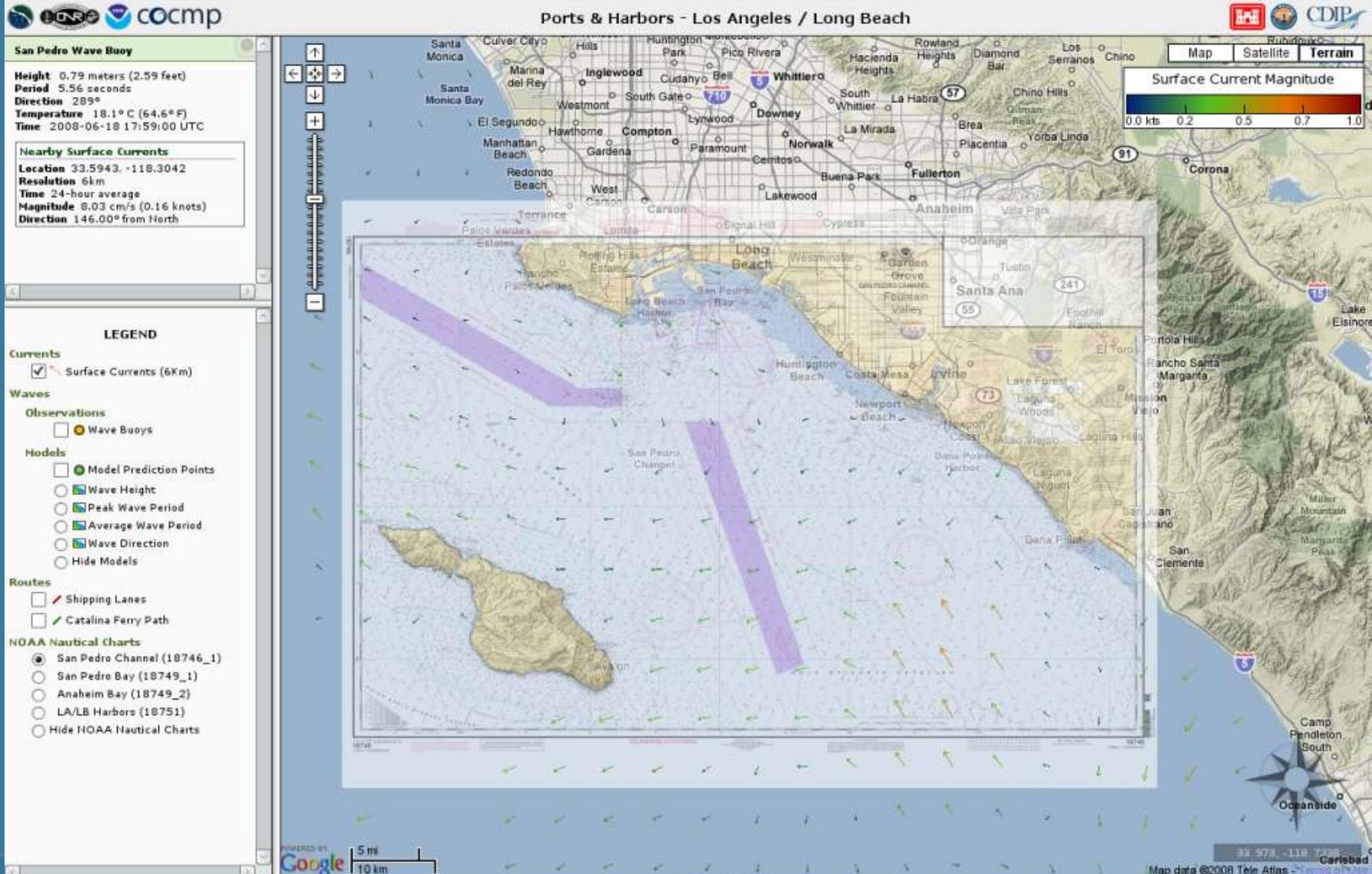
Example Applications/Products

- [Long Beach Harbor Product](#)
- NOS/CO-OPS Tidal Velocity
- NOS/OR&R HAZMAT Spill Response Trajectories
- SoCal Hyperion Wastewater Outfall
- NoCal Ocean Beach Wastewater Outfall
- S FL US Army Corps of Engineers Dredging
- U Miami-NOAA Coral Larvae Drift Modeling

Deepwater Horizon Spill Region



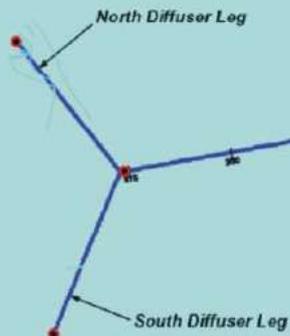
Example Application



Hyperion Outfall Diversion November 28-30, 2006

5-Mile Outfall Field Inspection

1. Multi-Beam Precision Scanning Sonar (entire length including diffusers, except in the shallow nearshore area)
2. ROV Inspection at Key Points (along entire length of outfall)
3. Internal Dive Inspection of First 2,500ft. of Outfall (entry from shore structure)
4. Pipe Coring at Indicated Locations
5. Internal Sonar Scanning of Part of Diffusers
6. Piezometric Testing at Indicated Locations
7. Geophysical Seismic Reflection Survey (Phase II, if needed along entire length of outfall, except nearshore area)



Legend

- 10 Pipe Cores
- 8 Piezometric Testing Locations

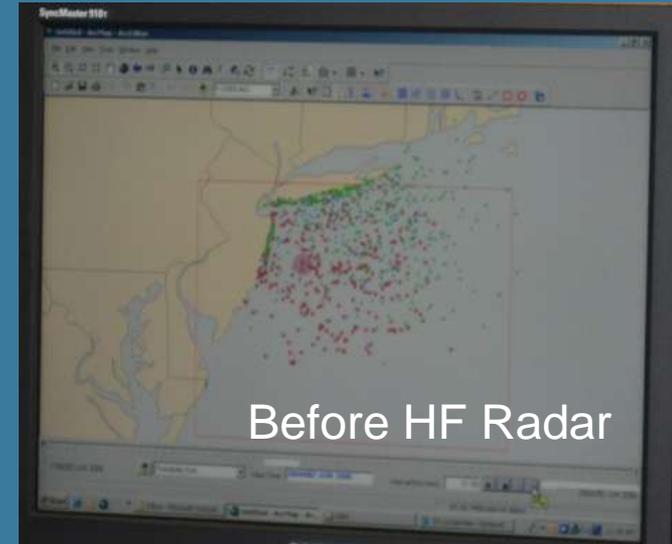
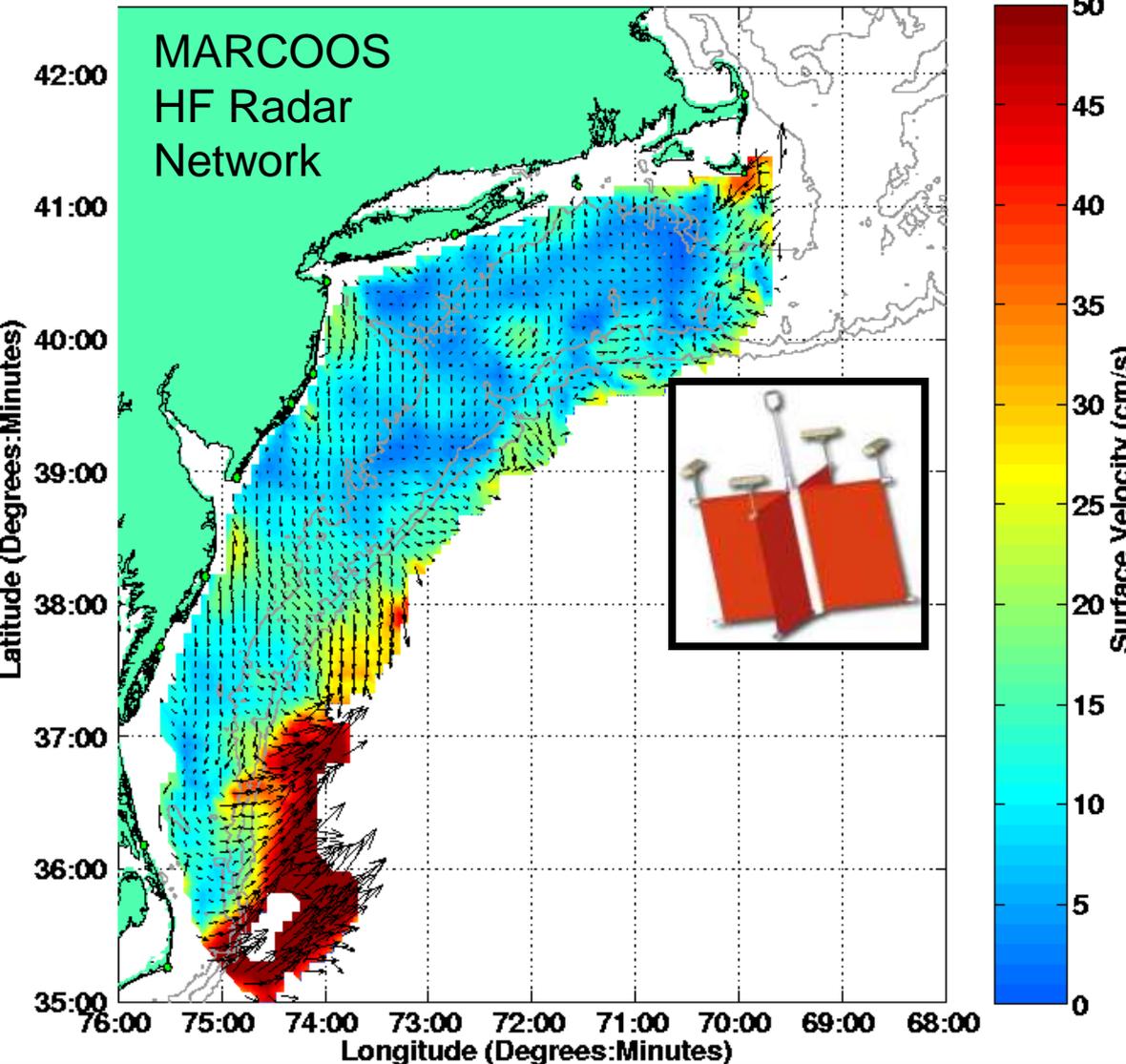
1-Mile Outfall Field Inspection

1. Multi-Beam Precision Scanning Sonar (entire length including diffusers, except in the shallow nearshore area)
2. Dive Inspection, 1,550ft. Encased Section
3. Dive Inspection of Undercut Section
4. Internal ROV Inspection 2,000ft. Offshore (entry from existing 18"x72" diffusers)
5. Internal ROV Inspection 2,000ft. Onshore (entry at shore structure)
6. Pipe Coring as Indicated to be Determined after ROV Inspection
7. Geophysical Seismic Reflection Survey (Phase II, if needed along entire length of outfall, except nearshore area)

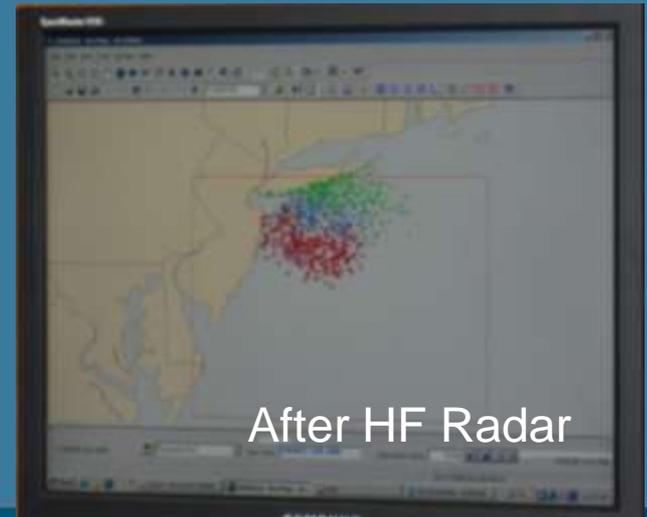
- Inspection of Hyperion Outfall Pipe (never internally inspected for 50 years). Serves City of Los Angeles. One of the world's largest coastal populations.
- Close to a billion gallons of sewage to be diverted to an in-shore/shallow outfall.
- Concern of extent of impact and public health risk in the Santa Monica Bay

Maritime Safety – Search And Rescue

Mid-Atlantic Raw Velocities (1 Day Avg) 2007/05/01 1000 GMT



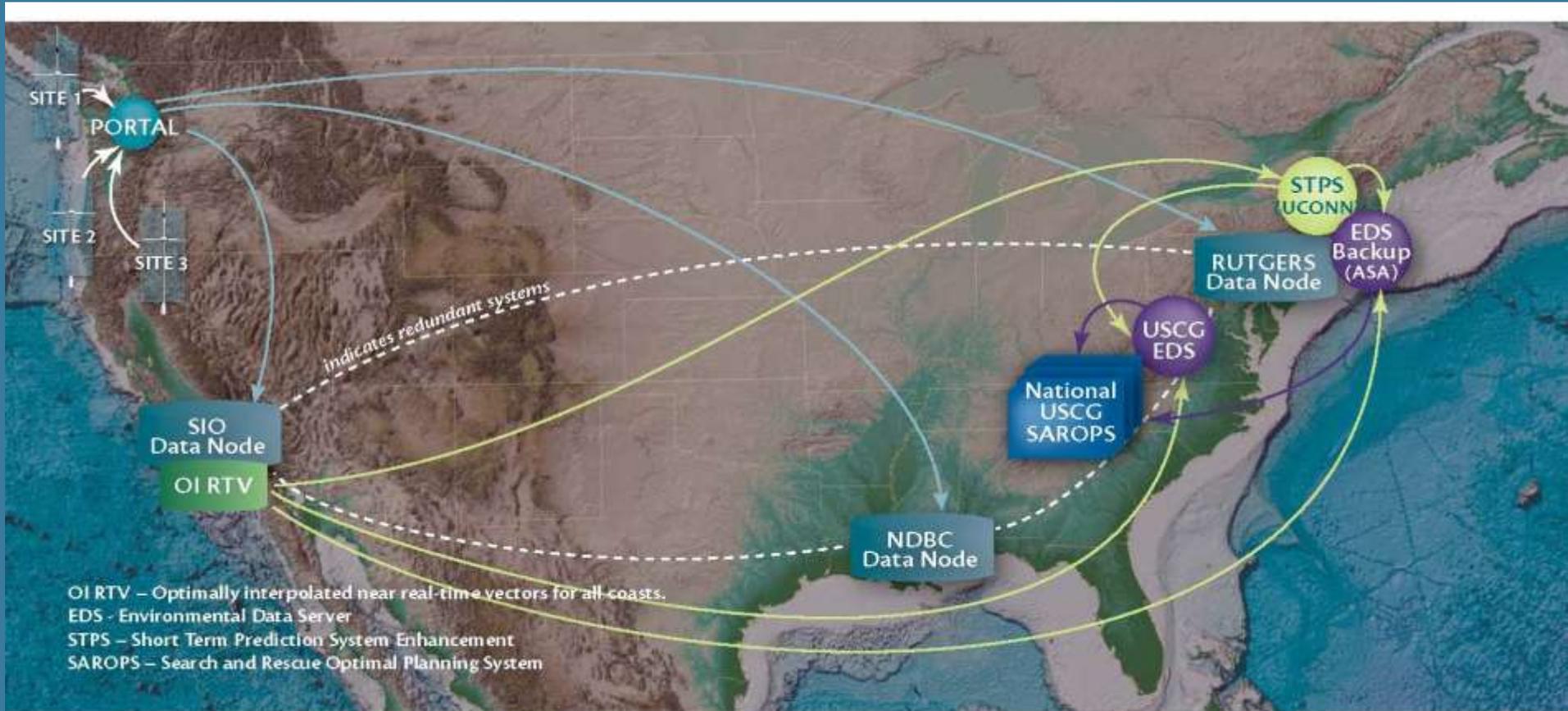
Coast Guard SAROPS



Present and Near Future IOOS Efforts

- International/national transmit licenses
 - January 2012 World Radiocommunications Conference
- Standards for Data, Files, Metadata, QC
- National Plan Released Sept 2009
 - Comprehensive: from Gap Analysis to Detailed O&M Procedures
 - Available at www.ioos.gov/hfradar
- National HFR data for US Coast Guard Search & Rescue with Optimal Interpolation (OI)
- SBIR: Using AIS for Antenna Calibration

Proposed USCG/SAR-IOOS Product



Summary

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Questions?

- Jack Harlan – jack.harlan@noaa.gov
- <http://www.ioos.gov/hfradar>